OAIP

ONTARIO
ASSESSMENT
INSTRUMENT
POOL

User's Guide for OAIP Mathematics, Junior Division

DRAFT

Ministry of Education

Hon. Sean Conway, Minister
Bernard J. Shapiro, Deputy Minister

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Introduction

The Junior Division Mathematics pool has been developed as a resource to assist teachers in the evaluation of student achievement related to the expectations for mathematics listed in The Formative Years, pages 11 and 12. It is composed of approximately 2000 instruments designed to assess objectives of arithmetic, measurement, and geometry identified with the Junior Division. The number of items in the pool allows for the assessment of different objectives related to a specific concept, principle, or skill. The variety of questions provides for the selection of instruments relevant to a specific classroom approach and for the adaptation of assessment to match locally designed curricular objectives. Many of the instruments suggest classroom activities which may be used to enrich the experiences of students.

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Evaluation

The goal of evaluation is to improve both student learning and the quality of the program (including materials, teaching, and assessment).

Effective evaluation of student achievement will:

1. provide the teachers, students, and parents with information regarding
   - what objectives have been achieved;
   - what level of understanding or skill development has been reached;
2. provide the teacher with information regarding
   - how effective the teaching/learning activities have been;
   - what future activities should be planned;
   - what topics or activities need revision.

An assessment program should include a variety of strategies. In the Junior Division, strategies which involve oral questions and responses or observation of the student manipulating materials are of equal importance as questions and responses in written form.

Whatever assessment instruments are used, they should match, both in form and content, what has been taught.

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Structure of the Pool

The Junior Division Mathematics Pool is organized as three packages. Each package represents one of the strands—arithmetic, measurement, and geometry.

The packages are further subdivided on the basis of sections, topics, and subtopics. In each case, Section 1 of the strand includes objectives related to the basic concepts including specific vocabulary and notation. Section 2 for each strand is Relationships. This section includes objectives involving relationships between and among concepts. The Topics and Sub-topics refer to major topics of mathematics associated with the Junior Division.

The sections, topics, and sub-topics for each of the strands are listed below:

ARITHMETIC

SECTION 1 : NUMERATION

WHOLE NUMBERS

Properties (counting, multiples, factors, order)
Representation (manipulatives, diagrams, place value, expanded notation)
Estimation (diagrams, rounding)

DECIMALS

Representation (manipulatives, diagrams, place value, expanded notation, written form)
Properties (order)
Estimation (diagrams, rounding)

FRACTIONS

Representation (diagrams)

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SECTION 2: RELATIONSHIPS

WHOLE NUMBERS

Operations (addition, subtraction, multiplication, division; word problems)

Arrays (graphs, tables)

DECIMALS

Operations (addition, subtraction, multiplication, division; word problems)

FRACTIONS

Operations (addition, subtraction, multiplication)

Arrays (circle graphs)

Since the Arrays subtopic of both Whole Numbers and Fractions involves graphs, these instruments have been placed together in the pool.

MEASUREMENT

SECTION 1: QUANTIFICATION

LENGTH

Standard Units (selecting appropriate unit)

Notation (conversion between common metric units)

Estimation

Measuring

ANGLES

Measuring (using protractor)

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AREA

- Arbitrary Units (selecting appropriate unit)
- Standard Units (selecting appropriate unit)
- Notation (conversion between common metric units)
- Estimation
- Measuring

VOLUME

- Arbitrary Units
- Standard Units

MASS

- Measuring (reading scales and balances)
- Estimation
- Standard Units
- Notation (conversion between common metric units)

TIME

- Estimation
- Standard Units
- Measuring (reading standard and digital clocks)

TEMPERATURE

- Estimation
- Measuring (reading liquid and dial thermometers; identifying reference temperatures)

SECTION 2: RELATIONSHIPS

LENGTH	AREA	VOLUME
Comparison	Comparison	Comparison
Problems	Problems	Problems

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MASS	TIME	TEMPERATURE
Comparison	Comparison	Comparison
Problems	Problems	Problems

GEOMETRY

SECTION 1: CONFIGURATION

3-D FIGURES
- Representation (models, diagrams, names)
- Properties (vertices, edges, faces; planes of symmetry)
- Everyday Uses

2-D FIGURES
- Representation (tracings, models, diagrams, names)
- Properties (vertices, sides; parallel, perpendicular; turn symmetry, line symmetry)
- Symbolic Notation (labelling)
- Everyday Uses

1-D FIGURES
- Representation (diagrams, names)
- Properties (end points)
- Everyday Uses

SECTION 2: RELATIONSHIPS

3-D FIGURES
- Comparison (faces, vertices, edges; symmetry)
- Classification (faces, edges, symmetry; perpendicular, parallel)
- Symmetry (line, turn, plane)
- Congruence
- Similarity

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2-D FIGURES

Comparison (vertices, sides, angles; perpendicular, parallel; line symmetry, turn symmetry)
Classification (sides, angles; symmetry; parallel, perpendicular)
Transformations
Symmetry (turn, line, slide)
Congruence
Similarity

In each of the packages, sets of instruments are further classified as to category—understanding (concept development), skills (facts and operations), and applications (simple problems).

While the pool at this time does not contain many instruments reflecting problem-solving of the open search type, some of the problems under the applications category will provide a challenge for many students.

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Instrument Code

Each instrument is identified by a code. The first group of three symbols indicates the section, the topic, and the sub-topic of the instrument. The next group of four symbols identify the objective within the sub-topic and the number of the instrument under that objective. The last two characters in the code provide classification on the basis of the stimuli used (C for concrete material, D for diagram, V for verbal-written or oral) and the form of the response (M for multiple choice, R for written or oral, S for sketch or diagram).

Thus C3R 0102 CM from the geometry strand can be translated as:

C - Configuration	(Section)
3 - 3-D Figures	(Topic)
R - Representation	(Sub-topic)
01 - Objective #1	(Objective Number)
02 - Instrument #2	(Instrument Number)
C - Concrete Material	(Type of Stimulus)
M - Multiple Choice	(Form of Response)

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Use of the Pool

The pool should be used as a resource for instruction and assessment. The board and/or classroom objectives for Junior Division Mathematics should be compared with those of the pool. Consideration should be given to including in the classroom program some objectives from the pool not currently part of the local program. This should be done with the recognition that the pool contains objectives spanning all the Junior Division and that a classroom concerned with a given grade need not include all the objectives.

Four uses are outlined in this section. The first is instructional; the remaining illustrate three types of assessment—pretest, observation, end-of-unit test.

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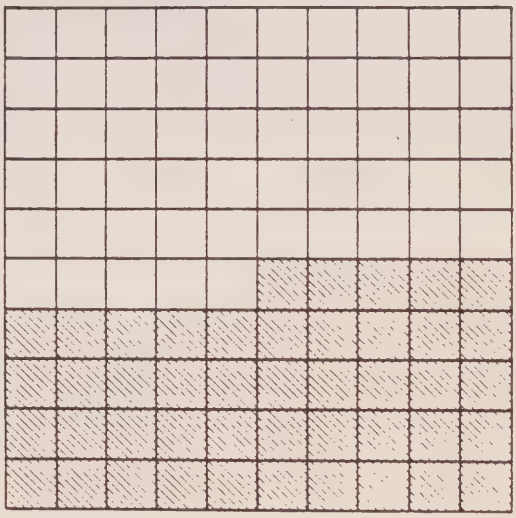
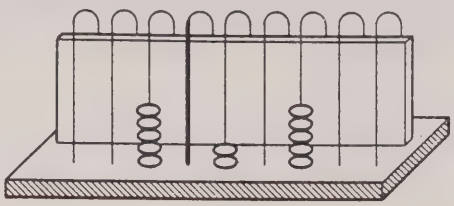
(a) Instructional Uses

After selecting objectives which match the classroom objectives, the instruments should be scanned for ones that may be used during instruction or which suggest instructional strategies.

For example, in a unit on decimals in a Grade 4 class, instruments such as the following suggest experiences with diagrams and concrete models which should be included in the program.

NDR 0103 DM	The decimal represented by the shaded area in the diagram below is  (A) 0.34 (B) 0.43 (C) 0.45 (D) 0.54

NDR 0106 DR	The diagram below shows an arrangement of beads on an abacus. The heavy bar is used to separate the whole number from the fraction. What number is represented by this arrangement of beads?  _____

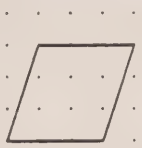
Questions involving a classroom abacus should precede those using the diagram. If another manipulative is used, consideration should be given to augmenting the pool with instruments involving diagrams of the manipulative which will be familiar to the students.

In the Geometry package there are many instruments which suggest instructional strategies. This is particularly true for those instruments involving concrete materials. For example:

C3R 0115 CR	Give the student the net for a tetrahedron. Say, "This net can be folded to make a model of a 3-D figure. What is the name of this figure?" _____	Tetrahedron or triangular-based pyramid
C3P 0401 CR	Give the student a set of 3-D models consisting of a sphere, a cone, a cylinder. Say, "Name one property that is shared by each of these 3-D figures." _____	Any common property such as: a curved surface or they all roll ...

Additional illustrations are found in Geometry, Junior Division, a Ministry of Education, publication, which supports The Formative Years.

A further illustration of instructional use is the language development which should be considered in relation to instruments such as the following.

R2C 0211 VR	Name one way in which a square differs from a rhombus. _____ _____
R2L 0105 DM	Which one of these does not describe the figure shown below?  (A) a polygon (B) a quadrilateral (C) a square (D) a rhombus ____

(b) Pretest

Many topics in mathematics for the Junior Division are developed in a continuous fashion from grade to grade. In such cases it is good practice to determine early in a unit what prior knowledge individual students have of the concepts and which concepts are only partially understood.

For example, in an initial unit on whole numbers in a Grade 5 class the following might be used as a pretest.

Name _____

Write the letter of the correct answer in the space.

1. The counting sequence 775, 770, 765 shows

   (A) counting forward by tens
   (B) counting backward by tens
   (C) counting forward by fives
   (D) counting backward by fives _____

2. Which sequence lists only numbers that are greater than 4093?

   (A) 4093, 4094, 4095, ...
   (B) 4093, 4092, 4091, ...
   (C) 4094, 4095, 4096, ...
   (D) 4094, 4093, 4092, ... _____

3. Which one of the following statements describes the number 5327?

   (A) It is 1 less than 5427
   (B) It is 10 less than 5427
   (C) It is 100 less than 5427
   (D) It is 1000 less than 5427 _____

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4. Which one of these numbers is divisible by 5?

(A) 3457
(B) 4052
(C) 5558
(D) 6795 _____

5. Which one of these numbers comes just before 3070?

(A) 2969
(B) 2970
(C) 3060
(D) 3069 _____

6. Which one of these numbers is 1000 less than 20 876?

(A) 20 876
(B) 20 776
(C) 19 876
(D) 20 875 _____

7. Counting forward by hundreds from 3076, the next three numbers are

(A) 4076, 5076, and 6076
(B) 3176, 3276, and 3376
(C) 3086, 3096, and 3106
(D) 3077, 3078, and 3079 _____

8. The expression (8 x 1000) + (7 x 10) + (5 x 1) represents

(A) 875
(B) 8075
(C) 8105
(D) 8705 _____

9. An expanded form for 807 is

(A) (8 x 10) + 7
(B) (8 x 10) + 70
(C) (8 x 100) + 7
(D) (8 x 100) + 70

_____

10.
$$\begin{array}{r} 3251 \\ +\ 423 \\ \hline \end{array}$$

(A) 7481
(B) 7274
(C) 3674
(D) 3494

_____

11. 8320 + 800 =

(A) 832 800
(B) 84 000
(C) 16 320
(D) 9120

_____

12.
$$\begin{array}{r} 8579 \\ -\ 456 \\ \hline \end{array}$$

(A) 4019
(B) 4523
(C) 8123
(D) 8114

_____

13. 345 x 6 =

(A) 6345
(B) 3456
(C) 2610
(D) 2070

_____

14.
$$\begin{array}{r} 321 \\ \times\ 13 \\ \hline \end{array}$$

(A) 9951
(B) 4173
(C) 1599
(D) 1284

_____

15. $3643 \div 4 =$

(A) 943 R0
(B) 913 R3
(C) 910 R3
(D) 900 R3

_____

16. $63\overline{)567}$

(A) 19
(B) 14
(C) 9
(D) 4

_____

After most students have had sufficient time to comfortably finish the test, the test papers can be exchanged and marked by the students using the answer key.

Answer key (for reference, the code numbers are in brackets)

1.	D	(NWP 0101 VM)	9.	C	(NWR 0903 VM)
2.	C	(NWP 0202 VM)	10.	C	(RWO 0110 VM)
3.	C	(NWP 0713 VM)	11.	D	(RWO 0123 VM)
4.	D	(NWP 0814 VM)	12.	C	(RWO 0209 VM)
5.	D	(NWP 0832 VM)	13.	D	(RWO 0317 VM)
6.	C	(NWP 0842 VM)	14.	B	(RWO 0306 VM)
7.	B	(NWR 0117 VM)	15.	C	(RWO 0402 VM)
8.	B	(NWR 0804 VM)	16.	C	(RWO 0417 VM)

A question-by-question summary of the results can be obtained by asking who has a correct answer for each question. A table such as the following would result (assuming a class of 30).

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Question Number	1	2	3	4	5	6	7	8
Number Correct	28	27	26	30	29	25	26	20

Question Number	9	10	11	12	13	14	15	16
Number Correct	21	30	29	30	30	25	22	15

An examination of the table in combination with the questions gives a good indication of topics which need little review and those which may require reteaching.

When the papers are collected, they should be scanned to identify students, if any, who have poor performance on a significant number of the objectives represented in the pretest so that they may be given individual attention. The students' work for questions 14, 15, and 16 should be analyzed to identify the types of errors being made.

(c) Observation

Observation strategies for assessment are particularly useful in measurement and geometry where diagrams, concrete materials, and measurement devices are involved. Observation can be used to verify a student's mastery of skills (e.g., measuring angles, measuring lengths) or of concepts (e.g., creating triangles on a geoboard, identifying nets of a solid).

Checklists are useful for recording observations. These checklists may be related to broad objectives or to component skills.

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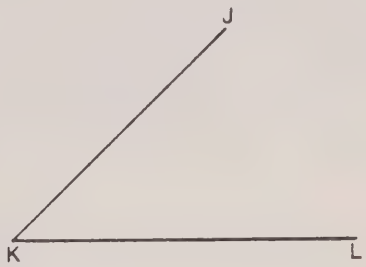
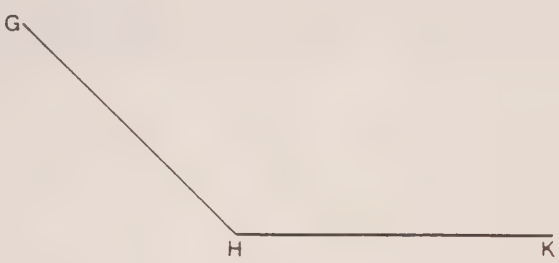
For example, the following instruments might be used in a unit on angle measurement in Grade 6.

QNM 0101 DR	Measure the size of angle JKL in this diagram.  Angle JKL is _____	Any measure from 42° to 48°
QNM 0102 DR	Measure the size of angle GHK in this diagram.  Angle GHK is _____	Any measure from 132° to 138°

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The accompanying checklist could be:

1. Measures acute angles with reasonable accuracy
2. Measures obtuse angles with reasonable accuracy

NAME	1	2
John Allen		
Barbara Ames		
Judy Collins		
.		
.		
.		

OR

1. Places base line of protractor along an arm of angle.
2. Positions centre point of protractor at vertex of angle.
3. Uses appropriate scale (inner or outer).
4. Measures angle with reasonable accuracy.

NAMES	ACUTE ANGLES				OBTUSE ANGLES			
	1	2	3	4	1	2	3	4
John Allen								
Barbara Ames								
Judy Collins								
.								
.								
.								

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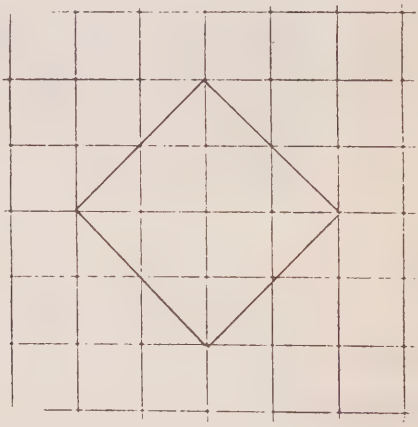
For a unit on area, the following might be used:

RAC 0202 CR	Provide the student with a sheet of centimetre squared paper and a ruler. Say, "On the squared paper draw as many rectangles as you can having an area of 8 cm^2. What could be the length and width of a rectangle having an area of 9 cm^2?"	9 cm, 1 cm or 3 cm, 3 cm

The accompanying checklist could be:

1. Draws rectangles 1x8 and 2x4 (horizontal).
2. Draws rectangles 8x1 and 4x2 (vertical), or recognizes that these are the same as the horizontal rectangles.
3. Rejects rectangles that are not 8 cm^2.
4. Draws square (creative response).



NAME	1	2	3	4
Jimmy Amos				
Carl Cohen				
René Como				
.				
.				
.				

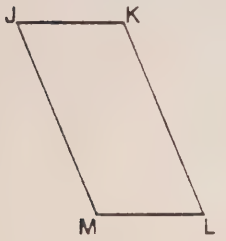
(d) End-of-Unit Achievement Test

The variety of questions in the pool provides for a good sample of concepts and skills to be assessed in an end of unit test.

For example, after a unit on area had been completed in a Grade 6 class, the following test could be given.

Name _____

1. The area of JKLM is 6 units. Which one of these units was used to make the measurement?



(A) 

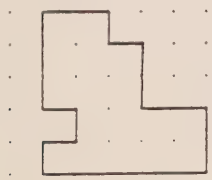
(B) 

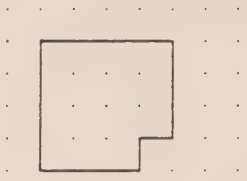
(C) 

(D) 

_____

2. Which one of the following figures has the greatest area?

(A) 

(B) 

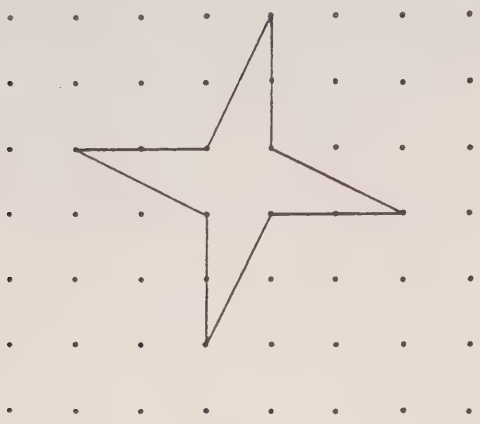
_____

3. Using the unit shown below, measure the area of figure 1.

Figure 1

_____ units

4. Estimate the area of this figure in square centimetres.



_____

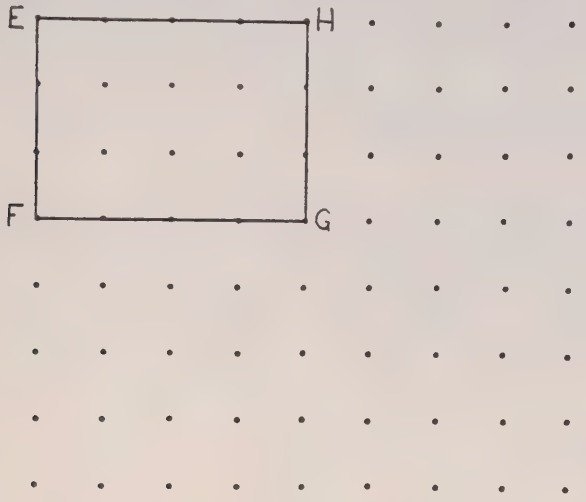
5. The carpet in a living room measures 12 square units. Name the standard metric unit used to make the measurement.

_____

6. How many square millimetres are there in 1 cm^2?

_____

7. Draw a square that has an area 3 cm^2 smaller than EFGH.



8. A roll of aluminum foil is 30 cm wide. How long a piece is needed to cover an area of 240 cm^2?

_____

9. Jose measured the length of the chalkboard as 220 cm. Helen measured the width as 1.5 m. What is the area of the chalkboard?

_____

Answer key (for reference, the code numbers are in brackets)

1. D (QAE 0102 DM)
2. A (RAC 0104 DM)
3. 5 units (QAM 0107 DR)
4. 5 cm^2 (QAM 0109 DR)
5. square metre (QAE 0109 VR)
6. 100 mm^2 (QAN 0103 VR)
7. a square 3 cm by 3 cm (RAC 0107 DS)
8. 8 cm (RAP 0219 VR)
9. 3.3 m^2 or 33 000 cm^2 (RAP 0222 VR)

Preparation of Master Copies of Tests

The simplest way to construct tests is to photocopy appropriate pages of the pool, cut out the chosen questions, and paste them on a master sheet to be used for photocopying the student papers. As the test is constructed, the answers provided should be recorded for use in marking.

Modifications of the Pool

Teachers may wish to make additions to their copy of the pool by inserting questions from their files under appropriate objectives. Coding these items in a similar way to other items in the pool would provide a useful means of referencing the additions. This modification of the pool would be particularly relevant with respect to activity items and those involving concrete materials which reflect the specific program of a given classroom.

For example, in considering the representation of decimals, besides having students sketch beads on a pictured abacus (NDR 0205 DS), the teacher may wish to give the students an abacus an ask them to show a number such as 6.305 on the abacus.

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Norms

Since the screening of the instruments was done in small numbers of classrooms, no norms for the province are available at this time. Local norms could be established by administration of the instruments throughout a school or board. As a step toward the development of norms, teachers may wish to record achievement data for specific instruments from year to year and share this accumulated data with other teachers both in the same school and in other schools.

Marking

No indication of the relative value to be placed on different questions has been given. This should be decided in relation to the specific application. Where work toward a solution is expected (e.g., computation, problem solving), sufficient marks should be allotted so that correct steps can be rewarded. In situations where answers contain two or more components (e.g., number and units in measurement questions, spelling in identifying geometric shapes and/or properties), it is good practice to allot sufficient marks for the answer so that credit may be given for the correct parts.